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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

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Applicant's or agent's file reference 2228478	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. PCT/AU99/00949	International Filing Date (day/month/year) 1 November 1999	Priority Date (day/month/year) 2 November 1998
International Patent Classification (IPC) or national classification and IPC Int. Cl. ⁷ G01J 9/00		
Applicant THE UNIVERSITY OF MELBOURNE et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheet(s).

3. This report contains indications relating to the following items:

- I Basis of the report
- II Priority
- III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV Lack of unity of invention
- V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI Certain documents cited
- VII Certain defects in the international application
- VIII Certain observations on the international application

Date of submission of the demand 19 May 2000	Date of completion of the report 15 March 2001
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer MICHAEL HALL Telephone No. (02) 6283 2474

I. Basis of the report

1. With regard to the elements of the international application:*

 the international application as originally filed. the description, pages 1-16, 18-34, as originally filed,
pages , filed with the demand,
pages 17, received on 9 November 2000 with the letter of 9 November 2000 the claims, pages 35-55, as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages , received on with the letter of the drawings, pages 1-12, as originally filed,
pages , filed with the demand,
pages , received on with the letter of the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language which is:

 the language of a translation furnished for the purposes of international search (under Rule 23.1(b)). the language of publication of the international application (under Rule 48.3(b)). the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, was on the basis of the sequence listing:

 contained in the international application in written form. filed together with the international application in computer readable form. furnished subsequently to this Authority in written form. furnished subsequently to this Authority in computer readable form. The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished. The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished4. The amendments have resulted in the cancellation of: the description, pages the claims, Nos. the drawings, sheets/fig.5. This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-109	YES
	Claims	NO
Inventive step (IS)	Claims 1-107	YES
	Claims 108-109	NO
Industrial applicability (IA)	Claims 1-109	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

Citation

D1 : Optics Commun. 133 (1997) 339-346

NOVELTY (N)

D1 represents the closest prior art cited in the International Search Report to the subject matter of the claims, and teaches phase retrieval via Fourier transforming a rate of change of intensity normal to a surface extending across a wave field; calculating and applying the inverse of a matrix operator (which is a function of the Fourier transform of the intensity over the surface), and taking the inverse Fourier transform (equations 3-4, 7, and 10 of D1). In contrast, independent claims 1, 27, 51, 65, 80, 94, 108-109 have, in place of the calculation of a matrix inverse as per D1, the mathematical operations of applying a first filter, an inverse transform, a correction factor based on the intensity over of the surface, a further transform, and a second filter (eg, steps (c)-(f) of claim 1). Hence the independent claims, and in consequence their respective dependent claims, are novel in the light of the prior art.

INVENTIVE STEP (IS) claims 108-109

Claims 108 and 109 are directed merely to a collocation of computer codes which can perform the mathematical operations of taking an integral transform and its inverse; filtering; and applying correction factors; and where the operations are suitable for application to intensity measurements of a radiation wave field. Such collocations are common general knowledge in the fields of digital signal processing and optical beam propagation, and are commonly provided in various computer packages for application to optical wave fields. Thus these claims lack an inventive step in the light of common general knowledge.

INDUSTRIAL APPLICABILITY (IA)

The subject matter of the claims is applicable to phase-amplitude imaging via radiation wave fields.

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

1. Claims 1, 27, 51, 65, 108 and 109 are not clear with respect to "rate of change of intensity ... over a selected surface" (lines 3-4 of claims 1, 27, 51 and 65; lines 2-3 of claims 108, 109) This has the plain meaning of change measured *transversely* to (ie, "over") the surface, whereas the embodiments and independent claims 80 and 94 imply that the rate of change is in "the direction of radiation propagation" (eg, lines 15-16 of claim 80). Perhaps it would be clearer if the direction of the rate of change was specified to be in the direction of radiation propagation.
2. Claims 108-109 are not fairly based because they do not include a method for phase retrieval of a radiation wave field, which from my reading of the specification as a whole (including the title), appears to be a characteristic feature of the invention.

where I is the intensity in the plane, the gradient operator in the plane is denoted ∇_{\perp} , k is the wave number of the radiation, and $\partial I/\partial z$ is the intensity derivative or rate of change of intensity. Note that $\partial I/\partial z$ is estimated from the difference of the measurements in the planes A & B shown in Figure 1, while the intensity I is given by the average of the measurements.

In order to obtain a solution to equation 1 the function A is first defined as:

$$(2) \quad \nabla_{\perp} A = I \nabla_{\perp} \phi$$

where the right hand side is assumed to be irrotational.

10 Thus equation (1) becomes:

$$(3) \quad \nabla_{\perp} \bullet (\nabla_{\perp} A) = -k \partial_z I .$$

Making use of a standard identity $\nabla_{\perp} \bullet \nabla_{\perp} = \nabla_{\perp}^2$, this may be written:

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$$(4) \quad \nabla_{\perp}^2 A = -k \partial_z I$$

where ∇_{\perp}^2 denotes the two-dimensional Laplacian acting over the surface of the image. This equation has the following symbolic solution:

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$$(5) \quad A = -k \nabla_{\perp}^{-2} \partial_z I .$$

If the gradient operator ∇_{\perp} is applied to both sides of this equation, it becomes:

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$$(6) \quad \nabla_{\perp} A = -k \nabla_{\perp} \nabla_{\perp}^{-2} \partial_z I .$$

The defining equation (2) for the function A allows (6) to be transformed into:

$$(7) \quad I \nabla_{\perp} \phi = -k \nabla_{\perp} \nabla_{\perp}^{-2} \partial_z I .$$